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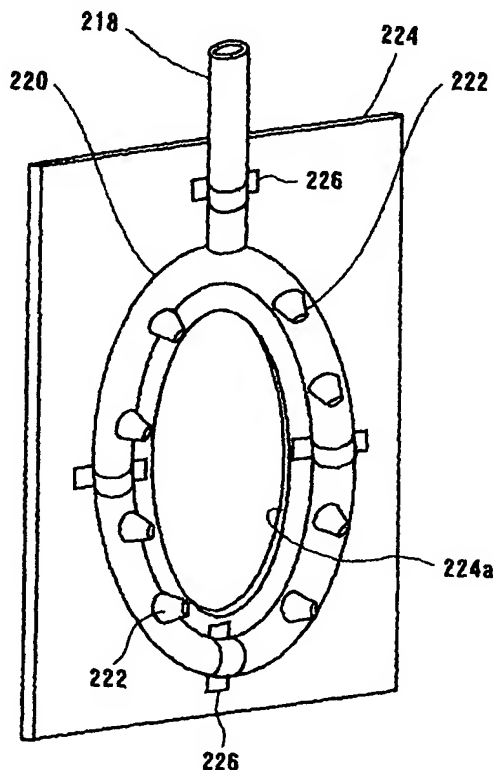
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[Continued on next page]

(54) Title: **PLATING APPARATUS**



(57) Abstract: The present invention is concerned with a plating apparatus for use in forming a plated film in trenches, via holes, or resist openings that are defined in a surface of a semiconductor wafer, and forming bumps to be electrically connected to electrodes of a package, on a surface of a semiconductor wafer. The plating apparatus (170) has a plating tank (186) for holding a plating solution (188), a holder (160) for holding a workpiece (W) and bringing a surface to be plated of the workpiece into contact with the plating solution (188) in the plating tank (186). A ring-shaped nozzle pipe (220) having a plurality of plating solution injection nozzles (222) for injecting the plating solution (188) to the surface to be plated of the workpiece held by the holder (160) to supply the plating solution (188) into the plating tank (186), or a stirring mechanism having a stirring vane are disposed in the plating tank (186).



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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER IPC 7 H01L21/288 C25D7/12 C23C18/54 C25D5/02 C25D5/08		
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B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 H01L C25D C23C		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the International search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data, PAJ		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 167 583 A (EBARA CORPORATION) 2 January 2002 (2002-01-02) paragraphs [0001], [0028] - [0030]; figure 3	1-10
A	EP 1 174 912 A (EBARA CORPORATION; KABUSHIKI KAISHA TOSHIBA) 23 January 2002 (2002-01-23) paragraphs [0001], [0244] - [0247]; figure 27	1-10
A	US 5 421 987 A (TZANAVARAS ET AL) 6 June 1995 (1995-06-06) column 2, line 58 - column 3, line 7; figures 1,3 column 4, line 25 - column 5, line 32 ----- -/--	1-10
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 8 March 2005		Date of mailing of the international search report 0 8. 04. 05
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer Hammerstein, G

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International Application No.

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C.(Continuation)-DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/027080 A1 (YOSHIOKA JUNICHIRO ET AL) 7 March 2002 (2002-03-07) paragraphs [0011], [0092], [0129] - [0132]; figures 20,21 -----	11,13
X	US 6 071 388 A (UZOH ET AL) 6 June 2000 (2000-06-06) column 1, line 50 - column 2, line 9; figures 2,3 column 4, lines 15-19 -----	11,13
X	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 11, 26 December 1995 (1995-12-26) & JP 07 210823 A (FUJI ELELCTROCHEM CO LTD), 11 August 1995 (1995-08-11) abstract -----	11,13
P,X	US 2003/153185 A1 (SAKAKI YASUHIKO) 14 August 2003 (2003-08-14) paragraphs [0009], [0021] - [0023], [0048] - [0052], [0063] - [0066]; figures 3-5,7 -----	15-17, 20,21
A	US 5 683 564 A (REYNOLDS ET AL) 4 November 1997 (1997-11-04) claim 12; figure 5 -----	15-19

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/003040

Box II Observations where certain claims were found unsearchable (Continuation of Item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of Item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-10

Claims 1-10 are directed towards a plating apparatus comprising a plating tank, a holder for holding a workpiece and a ring-shaped nozzle pipe in the tank for injecting plating solution toward the surface of the workpiece to be plated.

2. claims: 11-21

Claims 11-21 are directed towards a plating apparatus comprising a plating tank and a stirring mechanism having a stirring vane. Independent claims 11, 15, 18 and 20 define embodiments of the stirring vane, some of the claims with regard to a surface to be plated.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 1167583	A	02-01-2002	EP 1167583 A2	02-01-2002
			JP 2002080992 A	22-03-2002
			TW 562878 B	21-11-2003
			US 2004060825 A1	01-04-2004
			US 2002027081 A1	07-03-2002

EP 1174912	A	23-01-2002	JP 2002004091 A	09-01-2002
			JP 2001316877 A	16-11-2001
			JP 2001323398 A	22-11-2001
			JP 2001342573 A	14-12-2001
			JP 2002057199 A	22-02-2002
			EP 1174912 A1	23-01-2002
			CN 1341277 A	20-03-2002
			CN 1341166 A	20-03-2002
			EP 1179617 A1	13-02-2002
			WO 0148800 A1	05-07-2001
			WO 0148274 A1	05-07-2001
			JP 2001240996 A	04-09-2001
			TW 480580 B	21-03-2002
			US 2004069646 A1	15-04-2004
			US 2002020627 A1	21-02-2002
			US 2001024691 A1	27-09-2001
			JP 2002235192 A	23-08-2002
			JP 2002190455 A	05-07-2002

US 5421987	A	06-06-1995	NONE	

US 2002027080	A1	07-03-2002	EP 1229154 A1	07-08-2002
			WO 0168952 A1	20-09-2001

US 6071388	A	06-06-2000	NONE	

JP 07210823	A	11-08-1995	NONE	

US 2003153185	A1	14-08-2003	JP 2003306794 A	31-10-2003

US 5683564	A	04-11-1997	EP 0837158 A1	22-04-1998
			JP 10152798 A	09-06-1998
			TW 418261 B	11-01-2001
			US 5904827 A	18-05-1999
